

**AAM Ecosystem Working Groups
National Campaign Breakout 1**



What are your overall thoughts on the NC Series top-level goals? Improvements to the current language? What is Missing?		
Objectives	Improvements to the current language	What is missing
Accelerate Certification and Approval: Establish initial requirements to inform vehicle certification, pilot licensing, and operational approval.	JD Inform -> Enable?	Simulated testing before certification and procedures for accurate flight plan should be implemented within the simulation
	Agree with that (UAM license)	Add after scalability and safety the word security
	For piloted licensing requirements, the FAA should probably come up with a new Air Mobility pilot license.	Data sharing and privacy requirements
	Need to breakdown the various elements of approvals (e.g. SAC first, then OPA?)	Standards
	More information on a regulatory roadmap for certification, etc. is needed	How do we differentiate between pilot requirements for urban taxis vs. personal air vehicles?
	Licensing of autonomous systems	Work with FAA Aircraft Certification for initial certification
	Vertiport power requirements and impact on municipalities	What are the pilot licensing requirements for OPA?
	The use of "inform" seems vague	Flight test methods that are under development
	Pilot/Operator certification	Concept of Operations may be good to add. What will the approaches look like? That will impact aircraft performance requirements
	Safety target requirements	Requirements for pilots for urban taxis versus personal air vehicles
	Initial requirements and standards	Standardized instrumentation specs
	Indeed A and B on certification	Integration to existing infrastructure (airports, heliports, public transit)
	Systems Safety Assessment(s) - Tier 1, 2, 3, etc.	Aircraft maintenance updated policies
	Leveraging intersecting industrial standards - from AI to microprocessors	Certification of ground systems (as in UTM)
	Airworthiness standards and airman certification standards	Add airspace certification
		Addressing gaps in current requirements
		Need something on data sharing requirements. This is a big issue on ground based MAAS

**AAM Ecosystem Working Groups
National Campaign Breakout 1**

<p><i>Accelerate Certification and Approval:</i> Establish initial requirements to inform vehicle certification, pilot licensing, and operational approval.</p>		Add certification of air traffic management systems
		Eventual certifying body at endpoint
		Accelerate the regulatory process
		Infrastructure and community: funding, ownership, local regulation, community acceptance
		System certification (including subsystems)
		Weather intelligence for vertiports
		Instrumentation and pilot vehicle interface standards
		Testing during each phase
		eVTOL AW standards and eVTOL SVO airman cert STDs
		Needs a direct tie to procedures. How will approaches be done for example? That will impact aircraft requirements
<p><i>Develop Flight Procedure Guidelines:</i> Demonstrate refined flight procedures and related airspace design criteria that address scalability and safety. Develop preliminary guidelines for vertiport designs and implementation.</p>	Consider ConOps variations between urban and suburban	Preliminary guidelines for vertiport designs and implementation is likely its own objective. There is a technical piece (e.g. airspace and aircraft) and a separate set of guidelines for communities (e.g. zoning, first/last mile access, etc.)
	Focus should be on airspace management procedures	Are these only for land vertiports to start?
	Flight procedures or flight test procedures?	First step needs to be to establish a standard for communicating trajectory 4D definition and a two-way interface to trade information
	Categorize infrastructure needs based on aircraft configuration, app/dep speeds, app / dep angles, and rates of climb/decent	Scalability and safety require standardized formats, or at least interoperable
	Emphasis should be on airspace management procedures	Who are these flight procedures for?
	Future public funding? DOT provides development funding for airports (FAA_ and public transit (FTA)	What are the guidelines referring to?

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National Campaign Breakout 1**

<p><i>Develop Flight Procedure Guidelines:</i> Demonstrate refined flight procedures and related airspace design criteria that address scalability and safety. Develop preliminary guidelines for vertiport designs and implementation.</p>	Development of communication standards between the vertipad and aircraft with the assumption the future would not include a human operator	Can you have guidelines (e.g. an airport can be a piece of tarmac)?
	TERPS	Address security in flight procedures
	Increased specificity on safety/scalability (both very broad categories)	TERPS
	Flight test innovations are good but must be validated by actual testing	Efficiency and operational predictability should also be included
		Obstacle clearance requirements
		Needs vertiport certification, registration and database for tracking
		Need a better way to manage the vertiport database than the FAA has for heliports today
		Need a process for managing onboarding/offboarding of ports and managing accuracy of the data in the database
		Efficiency and operational predictability
		Missing emphasis on dealing with weather
		Do you have any architects working with you on building infrastructure?
		Emergency operations (search, research, first responder, etc.)
		Vertiport certification
		Local permitting
		Need certification of vertiport
		Initial design criteria to U.S.
		Define surveillance requirement at vertiport
		Security-related considerations and procedures
		Community acceptable flight procedures
		Ownership of implementation and inspection
		Recharging of eVTOL / power grid
		Should have direct emphasis on dealing with weather
		For mostly land based vertiports? I'm assuming...
		Security

**AAM Ecosystem Working Groups
National Campaign Breakout 1**

<p><i>Evaluate the communication, navigation, and surveillance (CNS) Trade Space: Assess industry supported CNS technology to establish initial requirements.</i></p>	Shouldn't the requirements drive technology innovation, rather than the other way?	Automation functions supported by digital data exchanges
	CNS performance requirements	Assess industry supported CNS technologies to establish "required" capabilities. Document required procedures for consistent communication
	What does "industry supported CNS technology" mean?	Navigation requirements during landing/takeoff and in route
	Define performance based CNS	Using mobile carriers signal for navigation and communication
	Does this working mean a trade study? I think it would be necessary to do one.	DAA
	Data privacy, access to flight path data	What is industry? Is it only vehicle? Assess vehicle and airspace
	Add interoperability methods to other modes of transportation or transportation entities?	Local funding responsibilities and investment planning/assurance
	Anti-Drone technology	5G integration
	Add metrics	The requirements need to be developed
	Add performance based requirements	Assessing industry supported current CNS may not provide necessary capability. Need to develop requirements for CNS to meet spacing and separation needs.
<p><i>Demonstrate an Airspace Management Architecture: Demonstrate and document a refined airspace system architecture capable of safely and reliably managing scalable AAM operations without burdening the current air traffic management system.</i></p>	ADS-B integration and interoperability	
	UAM should be included with AAM since UAM is on a similar scale	You need to define what system are you looking for
	Airport noise monitoring - integration with local airport systems	What are the considerations for UTM, that is UAS operations in same airspace
	Maybe add something about share of responsibilities (e.g. what role of FAA if any)?	Cybersecurity
	Airspace contingency planning	Identify piloted and remotely piloted integration objectives
	Have we defined what functions comprise airspace management?	Unplanned situation (i.e. earthquake, storm, etc.)
	Replace "burden" with "harmonize with ATM system	Redundant architecture
	On-demand vs. route based operation	Full UTM/ATM integration
	Add metrics	Integration or separation from existing system

**AAM Ecosystem Working Groups
National Campaign Breakout 1**

<p><i>Demonstrate an Airspace Management Architecture:</i> Demonstrate and document a refined airspace system architecture capable of safely and reliably managing scalable AAM operations without burdening the current air traffic management system.</p>	AAM operations entail a federated system of systems that should be connected with the current ATC system	Seamless integration with current ATM system
		Analysis of private vs. public
		autopilot in emergency
		Need to develop the requirements before you know what to demonstrate
		Cyber security
		Add in resiliency as well to any system
<p><i>Characterize Community Considerations:</i> Conduct expanded characterization and initial impact assessment of passenger and community considerations through community feedback and measurements such as vehicle ground noise, cabin noise, and on-board ride quality.</p>	Does it make sense to list flight paths?	Anything to do with the other modes of transport
	Locations of operations and noise safety considerations visual pollution	Fiscal benefits to a community
	Put measurement before feedback	Metric of sound quality based on multiple fleet operations
	"Visual" noise components as well	Experimentation may be good as well
	Consider additive noise, multiple vehicles vs. a single aircraft	Community acceptance to such technology
	Public funding - like FTA pays for 80% of a bus, can we have a grant to invest in AAM Capital Aircraft, or Innovation Development	Need to establish a consensus measure/metric for assessing ride quality
	DOT involvement in private local development plans?	Noise abatement considerations for communities
	Can we build a vertiport in a residential backyard or takeoff/land in a driveway?	Passenger acceptance app/dep angle and rate of ascent and descent
	Include a safety assessment	Consider environmental impacts such as air pollution, noise pollution
	Expanded airport noise monitoring - beyond large airports	Important to identify community "enabler" requirements such as power and rooftop availability
	Emergency parachutes (for aircrafts)	Also consider invasion of civilian privacy due to excess UAV travel. This means considering less invasive flight paths
	Could this include potential economic benefits to the community?	Determine minimum requirements for noise and emissions to inform requirements for manufacturers and city planners
	Will current commuters use air taxis? Or, will this be a new market?	Access to multimodal public transport

**AAM Ecosystem Working Groups
National Campaign Breakout 1**

<p><i>Characterize Community Considerations: Conduct expanded characterization and initial impact assessment of passenger and community considerations through community feedback and measurements such as vehicle ground noise, cabin noise, and on-board ride quality.</i></p>	Add metrics	Medical transport and first responder has different acceptance level?
	Characterize public impact considerations	This object may need to be divided into two
	Without buy in from the community and customer base, AAM will not move forward	Community and passengers?
	Would expect the public to have a low tolerance for incidents and accidents as indicated by the national academies in their AAM report	Environmental impacts (emissions, electrical utility on system)
		Visual clutter or "Sky-Clutter"
		Communities of concern, equity
		Legal liability for accidents
		Multi-modal contribution/impact
		Cost and viability of public/private partnerships
		Flight paths as well
		How do we deal with accidents when they do happen?
		Safety of people on the ground with large number of overflights
		Privacy concerns of large numbers of people and sensors flying overhead
Other	Has service provider models been considered or intended to be fleshed out as part of this?	Assess AAM as an integral part of multimodal commuting/smart cities
	Connection to other modes of transportation	What role will AI and robotics play in supporting a system for AAM and ultimately integrating both UAS and manned aircraft too
	Intermodal is centered on cargo	Leverage existing GA airports
		Workforce development
		Addressing any of the competing or different models from NC Series...basically why is the NC Series ecosystem the right one?

**AAM Ecosystem Working Groups
National Campaign Breakout 1**



What are your overall thoughts of the NC series timeline?			
Place the technologies listed in the correct timeline. Add numbers only in columns.			
NC - 1	NC - 2	NC - 3	NC - 4
14	3	11	9
1	16	10	11
12	19	12	20
4	6	2	10
5	18	16	7
15	14	18	4
17	1a	3	21
21	24	6	12
22	13	22	22
23	7	8	23
13	1b	24	5
19	15	19	8
1b	23	4	1a
25	12	1b	1b
6	4	5	19
24	21	7	25
1a	10	21	16
3	17	13	24
10	9	25	3
2b	25	14	18
5	22	20	14
16	2b	23	15
21	8	9	
25	2a	17	
18	21		
8	5		
9	8		
	11		
	25		

- 1.CNS Technologies
 - a) Vehicle
 - b) Airspace
- 2.Procedural leg library
 - a) Absolute and relative
 - b) Performance-based
- 3.Category A takeoff & landing procedures
- 4.UAM Vehicle Standards
- 5.DAA airborne and surface based
- 6.Aircraft – airspace interactions and interfaces
- 7.Aircraft-based merging and spacing validating 4d clearance without loss of separation
- 8.Adaptive trajectory planning
- 9.Full envelope autopilot
- 10.Automated contingency planning
- 11.Automated arrival, approach and departure procedures
- 12.Hazard perception and avoidance
- 13.Benchmark & demonstration nominal operations
- 14.Recovery from disruptions
- 15.Emergency procedures
- 16.Heliport/Vertiport configuration management (e.g. obstacles, winds, spacing, bandwidth)
- 17.Noise/annoyance assessment
- 18.Scalable prototype network in relevant environment
- 19.Interoperation with traditional traffic and ATM
- 20.Key attributes of UML-4 demonstrated, path to completing requirements and standards
- 21.Validated system architecture including major subsystems and interfaces
- 22.Operational evaluation across design conditions
23. Maintain efficiency with local disruptions
- 24.Safety/resilience in presence of systemic disruption
- 25.Community impact

Place numbers in either category, or add your own words.	
Drop	Delegate
7 (is not a good use of early capability development, should be later)	Should the NC take note from international community efforts of AAM already underway?
23 (how will you know at an early stage which disruptions will be visible at later stages?)	16
	4
	1b
	17
	25 (must be scoped properly & CAMI is running a great program on this & important to have individual public agencies input to provide some feedback)
	19
	21 (OEMs will do these)

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National Campaign Breakout 1**



What are your overall thoughts of the NC series timeline?			
What technologies are missing? Add suggested scenarios and contingencies.			
NC - 1	NC - 2	NC - 3	NC - 4
Pilot Incapacitation	Classification, communication, and contingency planning on vertiports in the event of a natural disaster, accident, or aircraft incident	Uncooperative Traffic (i.e. not broadcasting)	Hijack
Development of simulated environments	Mobile device integration (i.e. electronic flight bag)	Catastrophic failures with CNS systems	Autonomy
Implement locations for proper testing	UAM flight data exchange formats (similar to e.g. FIXM in SWIM for ATM)	Fleet-weather interaction	Onboard sensor architectures (and relation with CNS)
Micro-weather data	AI algorithms for system-wide trajectory planning and conflict detection	Spacing standards	Autonomous passenger carrying ops
Simplified flight controls	Simplified flight controls for lower pilot certification requirements	Sensors between buildings	Autonomous vehicle ops
Contingency recovery systems	Urban weather detection	Sequencing, including landings	UTM and City landscapes?
GPS denied ops	Ground based hazard avoidance for ground taxi operations		Start to think about removing the pilot from the cockpit to achieve full autonomy
Classification of rooftop airspace based on footprint of roof. Such as Class E Airspace but for rooftop space related to number of vehicles, etc.	Semi-autonomous emergency mission demo		Vertiport-based automation for air traffic control services
Public services mission demonstration	Downwash and building interaction		
Critical national infrastructure	Demonstrate a standard format for trajectory intent and negotiating adjustments		
FAA creation of the air mobility pilots license	Integration with airport terminals (infrastructure, flight paths, pax, and cargo ops)		
Uniform certification standards	DAA strategy		
Approved FAA vehicle	Automation		
Integration and interoperability			
Centers of Excellence (COEs)			
INCOSE approved systems resilience standards ID'd			
Supply chain management infrastructure			
Urban planning, including urban and regional policy makers throughout the steps of NC Series			
Confirmed seamless ADS-B integration			
Adequate representative vehicle performance data			
Vertiport design and separation standards			
electrical requirements on existing grid system			
UAM TERPS criteria			
Two VLOS operations with voluntary use of UTM for coordination			

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Is there an alternative approach that you would recommend for the series?
Rooftops are already a part of our infrastructure. Creating the logistical availability through sizes of rooftops
Performance standards should consider the operational impact to surrounding manned air systems
Continued collaboration internally (i.e. Transport Canada and NAV Canada have worked extremely well on past projects with NASA. How can we leverage these international relationships?)
Living lab sites are being set up for automated ground vehicles in the UK. The use of city based living labs in Lindon will be difficult, but we are trying to set one up at Cranfield
Separate path to evaluate community impacts
Create several adverse weather scenarios for all vehicle testing to ensure their safety in such conditions (e.g. high wind, snow, storm, etc.)
Planned red-team exercises to prepare for inevitable threats/hostile disruptions to AAM systems by bad actors (on ground or in aircraft)
Test components/elements separately before a more general campaign